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Functional Evaluation of the **JOHN DEERE 570 MOTOR GRADER**

CURRENT SERIAL RECORDS



U.S. DEPARTMENT of AGRICULTURE
EQUIPMENT DEVELOPMENT CENTER

FOREST SERVICE
SAN DIMAS, CALIFORNIA

EVALUATION OF THE
JOHN DEERE 570 MOTOR GRADER

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ABSTRACT

The John Deere 570 (JD 570) motor grader was tested and evaluated on the Fishlake National Forest. The evaluation was made while the JD 570 test-performed such routine forest road maintenance jobs as grading, scarifying, bank sloping, drifting, and dip construction and maintenance on a narrow, winding forest road.

The purpose of the evaluation was to determine if the JD 570 should be incorporated into the fleet to do light maintenance work in the confinement of narrow, winding roads. If the JD 570 proved successful, it would free larger motor graders for use on projects where they could operate at their greatest efficiency.

It was concluded that the JD 570, with its special features, could effectively, efficiently, and economically perform light maintenance work on typical forest roads.

INTRODUCTION

There are many miles of narrow, winding Forest Service roads that often need minimum maintenance work. Medium-sized motor graders, such as the Austin Western (AW) Super 300, are not used to their full potential in these efforts. The John Deere 570 (JD 570), a small-sized motor grader, was evaluated to see if such machines should be incorporated into the fleet for light road maintenance assignments. This evaluation, as presented in this report, relates to all small, articulated motor graders that are on the market or are being developed.

Though testing of the JD 570 motor grader was accomplished back in 1969, the resulting information is more pertinent than ever because:

- The Forest Service currently purchases this motor grader
- Other companies are beginning to manufacture articulated motor graders
- The new Forest Service road maintenance plan calls for several maintenance levels, determined by road use—the small, articulated motor grader fits into this plan.

The tests and evaluation of the JD 570 were accomplished through the combined efforts of the Division of Engineering, Intermountain Region, and the San Dimas



Figure 1. JD 570 Motor Grader.

Equipment Development Center. The various operational characteristics of the JD 570 were evaluated as they would apply to routine maintenance work. Our tests did not attempt to provide a full engineering evaluation. This report presents field observations of engineers and equipment operators made during road maintenance work in October 1969 on the Fishlake National Forest in south central Utah.

MOTOR GRADER DESCRIPTION

Overall

The JD 570 motor grader (fig. 1) was, when evaluated, a relatively new product of the John Deere Company, Moline, Illinois. It was promoted as a specialized machine for use in confined areas that would do well in fine grading and in moving considerable quantities of materials.

Table 1 presents 16 data items on the JD 570 plus two other small- and two medium-sized motor graders. These graders are just a few representative examples of the many makes and models that are available. Data on AW's Pacer 100 and Super 300 are in table 1; cost data on these machines are compared to JD 570 costs later in this report.

The JD 570 has six wheels (four of which are driven), front-wheel steer and lean, and hydraulic, rear-framed, articulated steering. It is equipped with a power-shift transmission, all-hydraulic blade control, and a lock-unlock differential. This type of differential prevents loss of traction if the driving wheels on one side encounter a slippery surface. The JD 570 also has an articulated rear frame for increased maneuverability and short turning radius.

Engine

The motor grader is powered by a John Deere direct-injected diesel six-cylinder engine, 83 (max) flywheel hp, rated under SAE standard conditions of 500-ft altitude and 85°F. Thus, the JD 570 has 68 less hp than the AW Super 300 (table 1). This means fuel consumption will be less when the JD 570 is used, instead of the AW Super 300, for tasks within the 570's capability.

Blade

The blade is 12-ft long, 24-in. high, and 5/8-in. thick. It can be rotated through 360° in the horizontal plane. The side shift from center position, with blade and circle extended fully, is 72 in. to the right and 77 in. to the left. The blade can be lifted 12 in. above the ground and rotated through any angle from horizontal up to 90° in the lateral plane (perpendicular to both the direction of travel and the ground plane) for bank sloping. All adjustments to the hydraulically actuated blade can be made from the cab.

Scarifier

The test machine was equipped with a front-mounted V-shaped scarifier, an optional

Table 1. Comparison of motor graders

	JD 570 ^{1/} (Small)	AW Pacer 100 (Small)	Cat 112F (Small)	AW Super 300 (Medium)	Cat 12F (Medium)
Total weight with cab (lb)	20,278	18,905	22,150	26,100	28,155
Horsepower	83	108	100	151	125
Length	26' - 8.5"	24' - 0"	25' - 8"	26' - 3 $\frac{1}{4}$ "	26' - 10"
Height	10' - 6"	10' - 4 $\frac{3}{4}$ "	10' - 5"	10' - 6 $\frac{1}{4}$ "	10' - 5"
Width	7' - 11 $\frac{1}{4}$ "	7' - 10"	7' - 9"	8' - 0"	7' - 9"
Transmission	Power shift	Direct drive	Direct drive	Direct drive or Power shift	Power shift
Turning radius	18'	34' - 6"	35' - 3"	34' - 6"	37' - 5"
Steering (front)	Hydraulic	Power driven	Mechanical	Hydraulic	Hydraulic
Steering (rear)	Articulated frame	Power driven	-	Hydraulic	-
Wheels x Drive	6 x 4	4 x 4	6 x 4	6 x 6	6 x 4
Controls	Hydraulic	Hydraulic	Powered mechanical	Hydraulic	Mechanical, hydraulic activated
Gears (forward)	8	6	6	6	6
Gears (reverse)	4	2	2	2	2
Speeds (mph)	2.0 - 21.6	2.76 - 22.00	2.2 - 18.6	2.69 - 21.40	2.0 - 20.0
Rental rates ^{2/}	\$12.25/hr	\$14.60/hr	\$13.50/hr	\$19.00/hr	\$19.25/hr
Estimated operating costs ^{2/}	\$2.05/hr	\$2.50/hr	\$2.30/hr	\$3.35/hr	\$3.15/hr

^{1/} The JD 570 has been replaced by the JD 570A, which has 3 more hp and is 228 lb lighter. Other than this, the JD 570A is approximately the same as the JD 570.

^{2/} Data source: National Research & Appraisal Co. 1973. Rental rate blue book for construction equipment. Equipment Guide-Book Co., Palo Alto, Calif.

accessory. Normally the 787-lb scarifier contains 11 teeth, but in this case every other tooth was removed, leaving 6. The tooth spacing was then a little over 9 in. center-to-center (fig. 2). Thus more rocks encountered on the test road would be left in place than if the teeth were closer together.



Figure 2. Scarifier.

Hydraulic Control System

The hydraulic controls are grouped for easy, natural operation from the operator's seat. The blade lift levers are both controlled by one hand, freeing the other hand for steering. Hydraulic controls are closely matched to machine function. For example, to lean the front wheels left or right, the operating lever is moved left or right. A T-shaped lever shifts the blade in the same direction as the lever is moved. To rotate the blade circle, the same T-shaped lever is rotated.

Modifications

Two modifications were made to the test grader. First a protection plate of 1/4-in. steel, reinforced by 1/4 x 2 x 2-in. angle steel on the sides and top, was placed under the engine and final drive unit.

The second modification is a spare tire carrier, allowing the spare tire to be mounted directly over the front wheels of the grader. Although this position might seem somewhat awkward, it does give the tire a permanent mounting on the grader for immediate availability in case of need. Some benefit might come from the added weight of the large 13.00x24 tire on the light front end, but this is just conjecture. The mounted spare tire is seen in figure 2.

TEST PROCEDURE

Test Site

The JD 570 motor grader was tested on the Monroe District, Fishlake National Forest, Intermountain Region. The particular stretch of road for conducting the tests was chosen because it required typical maintenance. This stretch of test road is located in Dry Creek Canyon, 12.4 miles southeast of Marysville, Utah. It begins at the forest boundary and continues approximately 7.5 miles northeast up the canyon. It is single lane, 10-ft wide. The road is maintained by the Forest Service for administrative needs.

There are a few culverts in the test road, but no ditches. Elevations range from about 7,000 ft at the beginning of the road to 9,250 ft above sea level at the upper end of the test stretch. This mountain road section contains a number of switchbacks (30-ft radius) and a maximum grade of approximately 13 percent (fig. 3 and 4). Most drainage is done by outsloping the road, so ditches are not necessary. Many intercepting dips are used for drainage. Almost the entire length of the test road contains rock embedded in the road surface.



Figure 3. Steep grades and high elevations.



Figure 4. Switchback curves.

Test Descriptions

Ten tests were conducted to determine the performance capability of the JD 570 motor grader on a variety of Forest Service road maintenance jobs.

Normal Grading

The object of the road maintenance test was to cut the outer edges of the road by an inward blading pass on each side, thus filling low spots with mixed material. The excess material at the center was then floated outward with one light pass, spreading the finer material on the road bed, and leaving a light windrow of oversized stone at the edge of the road. A half-mile section on the Dry Creek Canyon Road was marked off for the test.

Ditching

The ditching test's purpose was to determine the effectiveness of the motor grader under a heavy workload. The test was to cut a ditch to a depth of 18 in., with a fore slope of approximately 3:1. The material was then left as a windrow alongside the ditch for another test.

A 170-ft long section of the 10-ft wide test roadway was selected for the ditching test. The grade was 4 percent, and road material consisted of compacted soil with embedded rock. Elevation at the site was over 9,000 ft.

Scarifying

The object of the scarifying test was to break up the surface of a 75-ft section of road by running along the length of the section with the ripper teeth embedded approximately 6 in. The front-mounted scarifier, an optional accessory, was tested on a road section consisting of compacted soil and rock. Digging out embedded rocks from the roadbed and breaking up the surface to obtain loose material for normal maintenance operations are the two main uses of a scarifier in forest road maintenance work.

Bank Sloping

The bank sloping test involved sloping the blade to dress up or cut a bank to a designated slope. Several sections of the Dry Creek Canyon Road were used for the test. Grades ranged from 10 to 13 percent, and elevations were over 8,500 ft.

Bank sloping on Forest Service roads is usually done only during reconstruction or heavy maintenance work. Although sloping does not involve a large percentage of total volume, its occasional use does require a highly maneuverable blade assembly, which is one of the significant features of the JD 570.

Moving Material

The movement of material test consisted of two phases—drifting and casting a windrow. Drifting involved moving loose road-surface material for short distances up and down the road. Drifting is required continuously in normal maintenance operations to remove slides, fill washouts, and restore surfacing. In the windrow phase, material was taken from the windrow and spread out evenly across the road. A 150-ft long section of the road, on a 4 percent upgrade which had been used for the ditching test, was used for casting the windrow. The windrow was approximately 3-ft wide and 12-in. high.

Uphill Grading

Grading is the main job of a motor grader. It can be defined as preparing a surface to follow a given gradient and cross section. As uphill grading requires far more power and weight than downhill, the grading test for the JD 570 was to see whether or not it had the power and weight to blade steep grades while proceeding uphill. On some sections of the test, grades were as much as 13 percent. Roadbed material was chiefly hardpan, gravel, and solid rock, which the blade was expected to cut through, root out, and push up the hill, leaving a level surface behind.

Turnaround

The turnaround test was devised to demonstrate how quickly and efficiently the JD 570 could be turned around on a narrow mountain road. Figure 5 shows how the maneuver was expected to be accomplished.

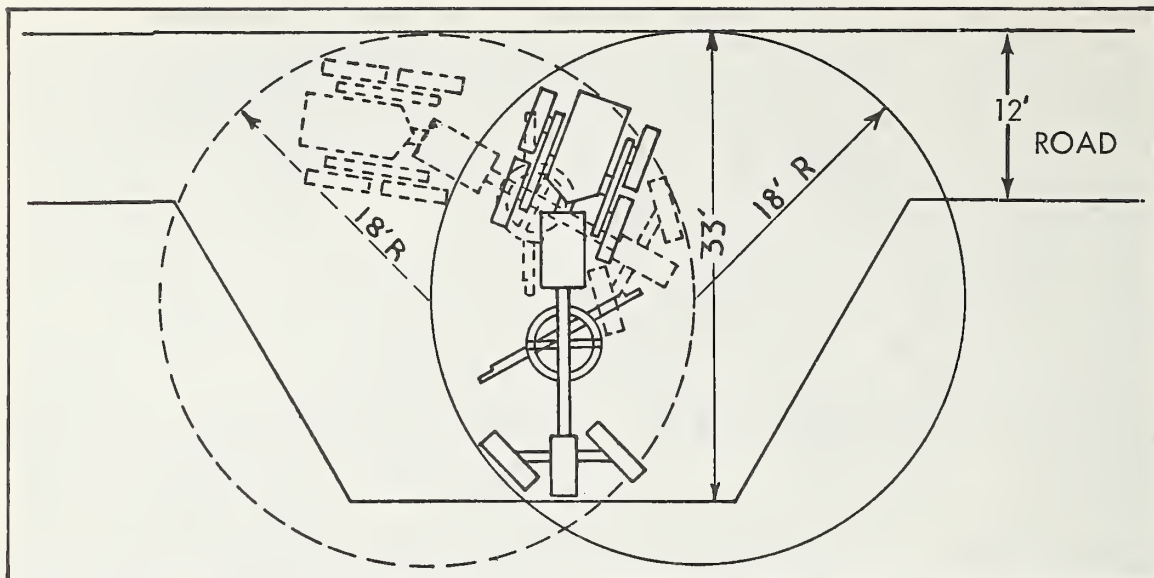


Figure 5. Plan for turnaround test.

Turning Radius

The turning radius test was set up to verify the manufacturer's specification that the turning radius of the JD 570 is 18 ft. To determine this, the following procedures were established:

- Turn front wheels maximum left
- Using articulated frame, turn driving wheels maximum right
- Drive machine in a complete (360°) circle
- Measure diameter of circle and divide by two.

Dip Construction

In mountain areas where the rocky topsoil makes drainage ditches impractical, it is necessary at periodic intervals to cut dips across the width of the road surface so that they will intercept water flow and conduct it off the road. The Dry Creek Canyon Road uses these intercepting dips exclusively for its drainage.

The construction and maintenance of dips involves moving several grader parts at the same time. For example, leaning and steering the front wheels while changing the angle and pitch of the blade. Good blade control is especially important, both above and below the original road surface. Blade control is also necessary in a vertical plane to take care of the increasing outslope, and in a horizontal plane to take care of the changing angle of outslope.

In the dip construction test, the grader was expected to construct a dip on a 12-ft wide section of the test road. This particular part of the road had a 6 percent grade; the road material consisted mainly of compacted soil.

Reverse Grading and Ditching

Reverse grading and ditching are just what the terms imply—the performance of grading and ditching operations while the grader is in reverse gear. Many narrow mountain roads have long distances between turnaround areas, so grading and ditching must sometimes be done in reverse gear. By ditching in reverse and blading the windrow over on the forward trip, the ditch can be completed on one side without turning the grader around. This test was set up to observe how well the JD 570 performed grading and ditching while in reverse gear.

TEST RESULTS

Operator Impressions

The operator's impressions of the machine were very favorable. Throughout the test the operator was impressed with the hydraulically operated blade, saddle, and circle, and reported that they were very smooth and positive and without kickback. The operator commented that the grader steered more easily than any other he has used. He also had high praise for the design of the cab, both for visibility and comfort. The blade is visible in nearly all operating positions. The operator also stated that the spare tire location does not detract from visibility.

The operator also praised the abilities of the machine to maneuver near rocks and stumps and to turn on narrow mountain roads, because of the articulated rear frame. During the test the operator commented that there was not sufficient blade lift. John Deere engineers are aware of this and agree that a modification is desirable. The 360° turning capability of the blade on the circle was praised by the operator as being very timesaving. However, it is possible to foul the tires with the blades if care is not taken during this operation.

The highest elevation at the test site was 9,250 ft. The reduction in power at this elevation was calculated at 19 percent, with a resulting output of only 67 hp. Although the engine performance was satisfactory at this elevation, the operator indicated a lack of horsepower when doing heavy work, which is something a turbo-charger option would rectify.

It was noted that there were deep marks on the lower side of the protection plate that had been placed under the engine and final drive unit. This indicates that it was struck many times while protecting the differential from damage. Additionally, the protection plate did not collect mud or dirt.

Performance Tests

Normal Grading

Based on the nature of the work required, it was estimated that the grader should be able to perform satisfactory maintenance with three passes. Not only was it able to do this, but the quality of the work was judged to be equal to that performed by the larger AW Super 300 in three passes. A forward speed of approximately 3 mph was

maintained during the work, with the actual time to maintain the half-mile section being 52 minutes. About 60 percent of the time, from start to end of test, was used for productive work, which is normal.

Ditching

The elapsed time of 26 minutes required to finish the 170-ft ditch to a depth of 18 in. (not including backups) was longer than an AW Super 300 would have needed, but this is not to imply that the JD 570 lacks the requisite power, speed, or ruggedness for this work. Rather, the lack of clearance between the bottom of the driving unit and the windrow on the JD 570 caused it to have to make more passes than did the larger grader.

Ditching places many extra forces on the grader, providing a good test for the ruggedness of the machine as well as its ability to obtain traction on a side slope while pushing material uphill (see fig. 6). The completed ditch was satisfactory. Incidentally, it was observed that the JD 570 would also do a good job of ditch cleaning on narrow mountain roads.



Figure 6. Ditching test.

Scarifying

The road surface was easily loosened 5 in. deep for a distance of 75 ft, requiring only 3 minutes. In addition, during the previously mentioned ditching operation, the scarifier was used to remove a very large (18 x 31 x 49 in.) rock from the road surface, which it then easily pushed aside. The operator commented that mounting



Figure 7. Scarifying road surface.

the scarifier in front of the wheels on the JD 570 is much more effective than mounting it behind the front wheels, as is the case on some other motor graders.

Bank Sloping

The most challenging aspect of bank sloping is encountering large rocks and heavy brush growth. The JD 570 was able to handle all of the heavy maintenance involved; but was not powerful enough to complete it without backing up several times and obtaining momentum in order to move heavy materials and rocks. Heavy bank sloping, then, is not its forte; but light motor graders are not expected to do this work as well as heavy motor graders.

For light bank sloping work, where the JD 570 has sufficient power and traction to complete the job in one pass, it would appear to be nearly ideal (see fig. 8). This grader can hold the blade in an infinite number of positions between horizontal and vertical. All changes are made hydraulically by the operator from the cab,



Figure 8. Bank sloping.

so no attachments are necessary. The heel of the blade can be positioned outside the plane formed by the face of the tires if the slope is $1\frac{1}{2}$:1 or steeper. This arrangement enables sloping while keeping the grader wheels off the slope. Positioning is usually difficult for even an experienced motor grader operator, but one who is familiar with this machine should have little difficulty obtaining any angle of bank slope.

Moving Material

Although no engineering measurements were made on the drifting phase, the evaluation team did observe that, with the power shift transmission feature of the JD 570, this type of material moving presented no difficulty. On the windrow phase, the machine easily moved the material of the 3-ft wide by 12-in. high by 150-ft long windrow without difficulty (see fig. 9). The material was feathered out evenly over the road surface.



Figure 9. Casting a windrow.

Uphill Grading

The quality of the work performed on the uphill grading test was excellent (see fig. 10), but production was less rapid than with a heavy grader. The effectiveness, in terms of production rate, seemed limited mainly by the horsepower. It negotiated proficiently adverse grades of up to 13 percent, and the blade cut through the rocky bedpan. The operator stated that the excellence of the hydraulic controls made good grading easy in both forward and reverse travel. The transition from forward to reverse grading presented no problem.

Turnaround

By following the plan diagrammed in figure 5, the operator reversed the direction the machine in a few seconds. The quick turnaround is made possible by the articu-



Figure 10. Uphill grading on a 12-percent upgrade.

lated frame and the lock-unlock differential, which allows the inside wheels to move more slowly than the outside wheels.

Figures 11, 12, and 13 are a photo sequence depicting the progress of the turnaround. At the start, the grader is pointed downhill on the narrow mountain road. Figure 13 shows the grader after the front wheels were turned right and the machine backed off to the right. In figure 14, the articulated frame enables the operator to swing the drive wheels to the left, and the machine proceeds forward and to the left.



Figure 11. Turnability -1.



Figure 12. Turnability -2.



Figure 13. Turnability -3.

Turning Radius

The turning radius test showed that the diameter of the circle of the JD 570 when turning was 35 ft, 7 in. The radius, therefore was 17 ft 9½ in., which is within the 18-ft limit specified by the manufacture (see fig. 14).

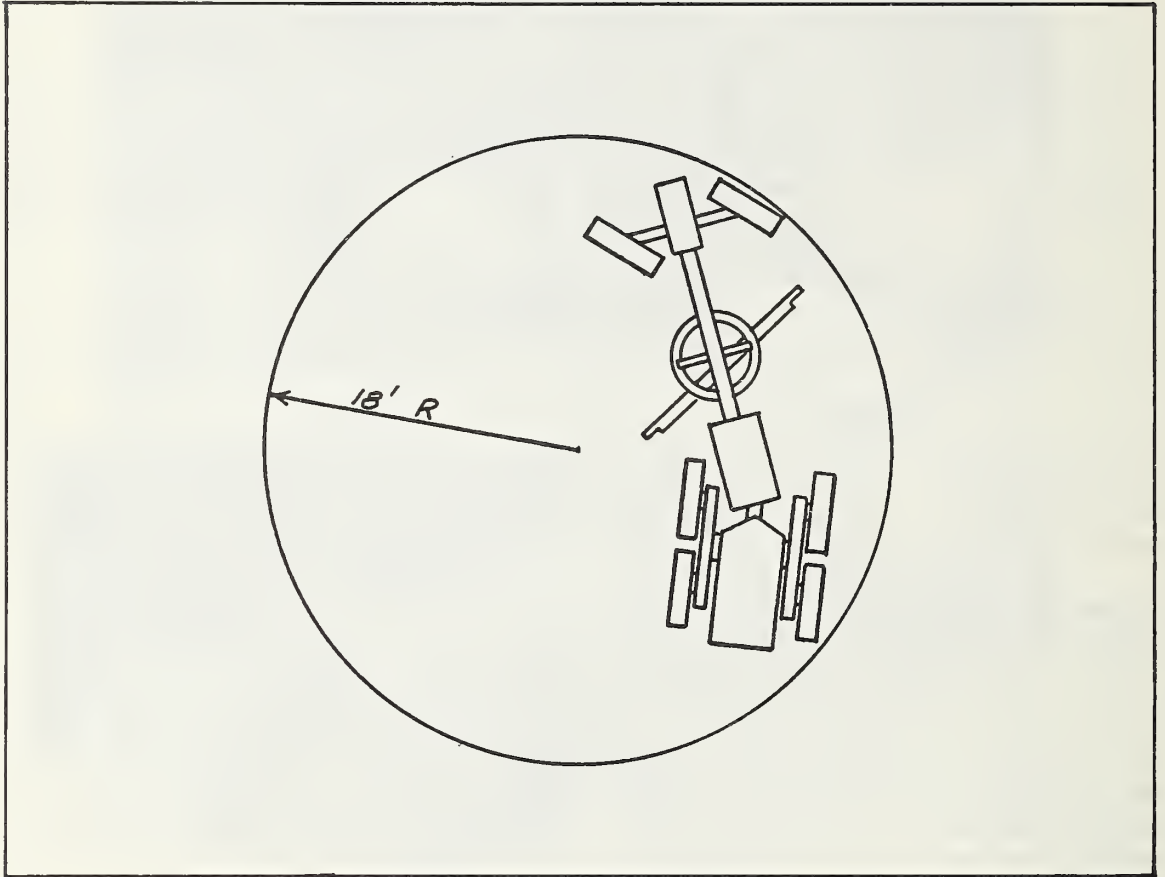


Figure 14. Turning radius.

Dip Construction

The grader easily completed the 75-ft length of the intercepting dip across the 12-ft wide road in 5 minutes. The articulated frame aided the operator in positioning the machine while constructing the dip. Although blade control in general was excellent, there were some problems in clearance caused by the design of the hydraulic arms which are used to raise the blade.

Reverse Grading and Ditching

No problems were encountered while grading in reverse. Changing the blade from forward to reverse ditch-cut required a movement of only about 70°. Reverse and forward movements were used in casting a windrow toward the center of the roadway.

ADDITIONAL OPERATIONAL DATA

Malfunctions

The Fishlake and Sawtooth (southern Idaho) National Forests each used JD 570 graders, providing a total of 964 hours experience on road maintenance during a six-month period. Two malfunctions occurred during this time. However, because of the warranty service provided by the manufacturer, downtime was almost nil. No mechanical weaknesses intrinsic to the design or construction of the grader were observed.

The first malfunction was in the final drive unit. The cap screws on one of the tandem rear-wheel sprockets worked loose, and the drive chain fouled them. Failure was promptly repaired under warranty.

The second failure was a crack on the lower weld of the moldboard. The crack was repaired by a local welder, who ran a continuous bead along the length of the mounting assembly.

Cost Comparison

The results of a cost comparison between the JD 570 and the AW Super 300, made by personnel of the Fishlake National Forest, are as follows:

	<u>Costs (\$/Mi)</u> ^{1/}		
	<u>Equipment</u>	<u>Labor</u>	<u>Total</u>
AW Super 300—1968 rates	41.20	39.93	81.13
John Deere 570—1969 rates	39.54	30.82	70.36

As an additional cost comparison, hourly rental rates and estimated hourly operating costs for use of this equipment, as well as the AW Pacer 100, are:

	<u>1973 Rates (\$/Hr)</u> ^{2/}	
	<u>Rental rate</u>	<u>Estimated operating costs</u>
AW Pacer 100	14.60	2.50
AW Super 300	19.00	3.35
John Deere 570	12.25	2.05

^{1/} Forest Supervisor, Fishlake National Forest. 1969. Personal correspondence. USDA Forest Serv., Richfield, Utah. [On file at Regional Office, Ogden.]

^{2/} Same data source as footnote 2, table 1.

CONCLUSIONS AND RECOMMENDATIONS

In summary, the results of the tests indicate that the John Deere 570 has these characteristics:

1. Outstanding performance in:

- General grader mobility
- Maneuverability on narrow, steep mountainous curved roads
- Blade manipulation—however, maneuverability of the blade from the normal blading position to the backsloping position appears to be somewhat awkward; nevertheless, it is the opinion of the observers that, with additional operating experience, this problem will be corrected.

2. Smooth, positive control for each function. Hydraulic locks prevent creep or drift. Hydraulic controls are matched to machine functions. All functions of the machine are controlled by the operator from the operator's seat.

3. Excellent visibility from the cab in all directions.

4. The lock-unlock feature of the driving wheels prevents both tire scuffing in tight turns and excessive rear tire skidding.

5. The articulated feature provides for controlled traction, enabling the grader to blade the road surface with a cutting action and to follow the toe of the cut bank without difficulty. The load is well balanced, and material is shed freely to the side.

6. The power-shift transmission holds the load to the power source, and the applied power to the load, smoothly and efficiently. The transmission protects against shock load, engine lugging, and stalling.

7. The articulated feature makes it possible to maneuver closely around objects such as stumps, trees, and culverts. The ability to swing the driving wheels right or left keeps them out of wet or soft ditches that would cause loss of traction and side stability, and greatly reduces the possibility of getting stuck.

8. Ability to grade and ditch in reverse on forest road maintenance is quite satisfactory.

9. The cost of owning and operating the JD 570 is considerably less than for the larger AW Super 300.

10. The JD 570 can be effectively and economically incorporated into the road maintenance equipment fleet.

11. This grader is capable of handling normal road maintenance, but heavier work will still require larger, more powerful graders.

12. If there is a sufficient amount of work it can handle, proper scheduling will enable the JD 570 to reduce overall road maintenance costs.

13. If the JD 570 grader were to do a predominant amount of its work at higher elevations, a turbocharged engine might be a desirable option.

